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with

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CHEMISTRY OF THE ATMOSPHERE

OF THE PLANET VENUS

Microwave Emission from Chemical Reactions

Investigations have been carried out using a variety of experimental arrangements in an effort to determine whether the emission of microwave radiation may accompany certain chemical reactions. As previously reported[1] the first experiments along these lines were performed with a simple antenna pickup held adjacent to a glass flask. With this relatively crude arrangement signals were detected from an intense glow discharge through SO_2 and CO_2 (but not air or oxygen) at levels of about 1-2 db above normal background. The minimum sensitivity of the receiver used was about 10^{-12} watts.

With the same receiver a new set of experiments was carried out using a waveguide noise generator (X-band) in an effort to increase the efficiency of detection of the signal. The argon-filled tube originally a part of the noise generator was replaced by a tube through which any desired gas could be passed. With this arrangement signals of about 25 db were obtained for a discharge through SO_2, about 10-15 db for a discharge through CO_2, and 0.5 - 1 db for air or argon. The question of greatest interest, i.e., whether microwave emission also is generated by the chemical reactions alone, outside a discharge, could not be answered with this apparatus because the diameter of the glass reaction tube was so small (6mm O.D.) that oxygen atoms recombined on the walls before reaching the reaction zone within the waveguide. Several experimental modifications including by-passes and U-tubes were tested to try to overcome this problem but in none could the light emitting reaction be obtained inside the waveguide.

Since the small size of the waveguide appeared to be the limiting factor in preventing reaction from occurring, the next efforts utilized larger waveguides. A new receiver was obtained which has a minimum sensitivity of about 10^{-13} watts, an order of magnitude better

(1) Technical Status Report No.1

than that previously available. Again experiments were confined to the X-band region. This was because the best receiver sensitivity could be obtained in this region and also because the intensity of any microwave radiation emitted should be expected to be greater at shorter wavelengths. A series of tapered waveguide transitions from S-band to X-band was obtained and it was planned to allow the reaction to occur in the large, S-band, end from which it would be transmitted to the X-band end and then into the receiver. A great many problems were encountered with this arrangement, many of them in connection with efforts to use the waveguide itself as a reaction chamber, and no signals were detected. Several alternatives incorporating hybrid tees to eliminate the necessity for U-tube arrangements were also investigated but again no signals were detected and a check showed that a discharge through SO_2 gave much less signal than had been obtained with the noise generator.

A new approach has recently been investigated at the suggestion of Dr. Holt of R.P.I. This arrangement returns to an X-band waveguide as a reaction chamber but uses a square rather than a rectangular guide to allow a greater volume in which the reaction may occur. To date no signals have been detected using this arrangement but experiments are continuing.

Further work is planned along these lines using all the experimental arrangements described above in continuing effort to determine whether in discharges through SO_2 and CO_2 in which chemical reactions such as

$$SO + O \rightarrow SO_2 + h\nu$$
$$CO + O \rightarrow CO_2 + h\nu$$

are surely occurring, the observed emission of microwave radiation is related to these reactions.

Photochemical Studies Using Iodine Lamp

This new photochemical lamp, described in the previous Technical Status Report (2), is being used for new experiments. The lamp has been modified to allow air to be blown through an annular space between the iodine discharge tube, and the concentric reaction chamber. This prevents

the heating previously observed during the lamp operation and eliminates many spurious effects. Experiments now in progress are concerned with the irradiation of liquid CO using a smaller irradiation cell cooled to liquid nitrogen temperature which facilitates observation and measurement of any suboxide polymer products.

Publications and Presentations

A paper entitled "Ultraviolet Absorption Coefficients of CO_2, CO, O_2, H_2O, N_2O, NH_3, NO, SO_2, and CH_4 between 1850 and 4000 A" was published in the December 15, 1963 issue of the Journal of Geophysical Research.

A paper entitled "The Iodine Lamp: A Light Source for Selective Excitation of CO" will soon be published in the Zeitschrift fur Naturforschung in a special issue in honor of the 60th birthday of Dr. W. Groth.

Recently Dr. Harteck gave lectures on the work described in this report at a meeting in Bonn, Germany.